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Low Cost IoT Based Home Smart Locker to Receive Online Shopping Packages

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Abstract— The easier it is to access the internet, almost all human activities are helped. One example is the sale and purchase of goods to the delivery of the ordered goods to the buyer's house. This is increasingly widespread after the emergence of several marketplaces that collaborate with shipping service providers to deliver ordered goods to buyers' homes. Problems occur when the shipping courier who comes to the buyer's house does not meet the buyer or the buyer's relatives to receive the ordered goods. So that there is a tendency for the courier to put the ordered goods in any place which can cause the goods to be lost. Based on this, a solution will be given in this research, by making a low-cost smart locker for home users to receive goods ordered from online shopping safely without having to meet face-to-face with conventional buyers. In addition to helping receive goods automatically and safely, the use of this smart locker will also minimize buyer contact with couriers directly, in order to break the chain of spread and transmission of several viruses, including Covid-19.

Keywords: low cost smart locker, marketplace smart locker, IoT.

1. Introduction

In Indonesia, there are several marketplaces that sell various kinds of goods ranging from new to used. The journey of e-commerce in Indonesia began in 1999 which became the beginning of the birth of e-commerce in Indonesia, the KASKUS Forum became the forerunner of an online store in Indonesia founded by Andrew Darwis followed by Bhinneka.com which is also a place for buying and selling online in Indonesia [1]. The marketplace has collaborated with shipping service providers to deliver ordered goods to the intended recipient's address, so that buyers only need to monitor the shipping of the goods ordered based on the receipt number using the same application or web tracking application from the shipping service.

All shipping services that have collaborated with the marketplace have been functioning properly, delivering order packages from the seller's place to the buyer's place based on information when buying and selling transactions occur. Constraints arise if the shipping courier does not meet directly with the buyer or recipient of the order package due to many things, for example the destination house is empty because he is left with school or work activities. With such conditions, couriers will usually put the ordered package in any place that is not safe, so it is very possible to be taken or stolen by someone else. In big cities or in developed countries, the use of smart lockers to receive order packages from online shopping is common, especially in large offices, apartments or hotels. The locker consists of many rooms that can be used privately by each recipient of the order package.

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If the package has been entered into the smart locker, the recipient will get a notification on their smartphone so they can know that the ordered item has arrived and is stored safely in the smart locker. Nowday, we are heading to the next phase, where it is not only smartphones or computers that can be connected to the internet. But various kinds of real objects will be connected to the internet. For example, it can be: production machines, cars, electronic equipment, wearables, and including any tangible objects that are all connected to local and global networks using embedded sensors and or actuators [2]. While "Things" on the internet of things, can be interpreted as objects from the physical world that are taken through sensors which are then sent via the internet [3].

With the smart locker, the recipient of the packages also does not have direct contact with the shipping courier. This will also minimize the transmission and spread of the Covid-19 virus during the pandemic. On the other hand, the shipping courier will also be greatly helped to speed up his work because he no longer has to wait too long to deliver the ordered package to the recipient directly.

2. Method

This research was conducted in two stages. Rapid Application Development (RAD) method was used in this work. Rapid Application Development (RAD) is a software development process model that emphasizes a very short development cycle. The RAD model is an adaptation of the linear sequential model where rapid development is achieved using a component-based construction approach. RAD emphasizes the development of program components that can be reused (reusability) [4]. Rapid Application Development (RAD) is an incremental software development process, which emphasizes a very short development cycle. For the development of a normal information system takes a minimum of 180 days, but by using the RAD method a system can be completed in only 30-90 days [5].

2.1 Data Collection

The data collection stage will include a study of library sources that support this work. A simple IoT-based cheap smart locker security system designed for domestic and office lockers, which is very useful for people to store their jewelry, money, and valuable documents using Arduino with GSM module and biometric scanner [6]. An RFID-based smart locker design that is used as a storage medium for goods that is integrated with an integrated online marketplace system with a smart locker equipped with a microcontroller and an RFID reader to validate a transaction [7]. The manufacture of lockers with double security also was made which aims to overcome goods security problems for customers and shop owners. The locker with a dual security system uses a keypad and RFID as an access code, an LCD as a display of the sequence of use of the tool, an LED as an indicator and an Arduino Uno as a controller and data processor [8].

2.2 Design

A. IoT Device Design

To design an IoT device, some hardware is needed. Each of the hardware has different functions according to its use. Once the hardware is assembled, then a program is given to give the desired instructions. The program uses the Python programming language on the Raspberry Pi Zero W platform.

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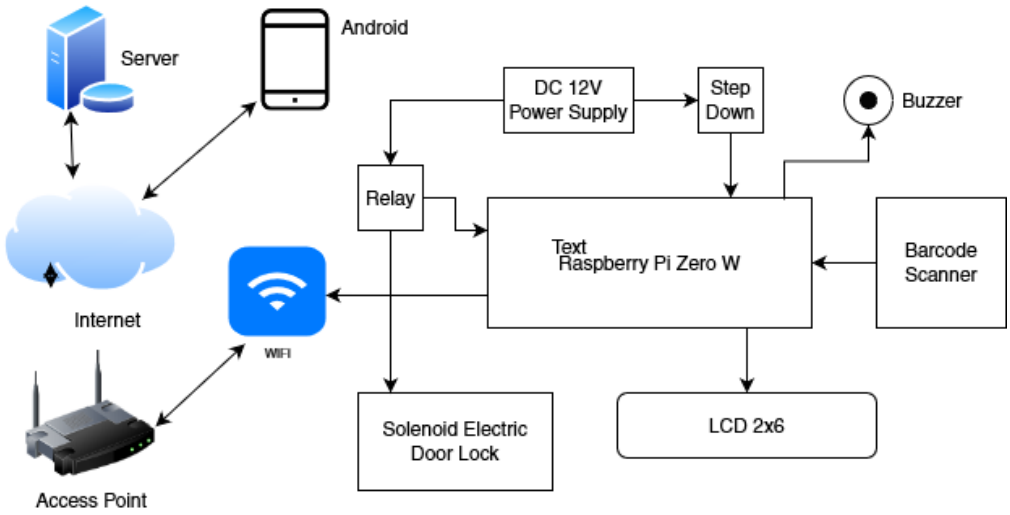


Figure 1. Block Diagram of IoT

Figure 1 shows the Smart Locker device that has an IoT network installed, which consists of:

1. Raspberry Pi Zero W which contains programs as the operator center.
2. Barcode scanner, for scanning barcodes on package that will be put into the Smart Locker.
3. Solenoid Electric Door Lock, which will open the Smart Locker automatically when the package barcode scanning results are correct or found in the database.
4. LCD 2x6, to display current status of Smart Locker.
5. Buzzer, will emit a beep sound as an indicator of the instructions given, for example when the barcode of the package has been successfully scanned.
6. Relay, as an electric switch to control the Solenoid Electric Door Lock.
7. Step Down, to change the 12v voltage to 5v as a Raspberry Pi Zero W supply.
8. Access Point, as an internet connection access media from Smart Locker.
9. Server, to store receipt number data from packets that will be entered into Smart Locker.
10. Android smartphone, to enter and monitor packet data.

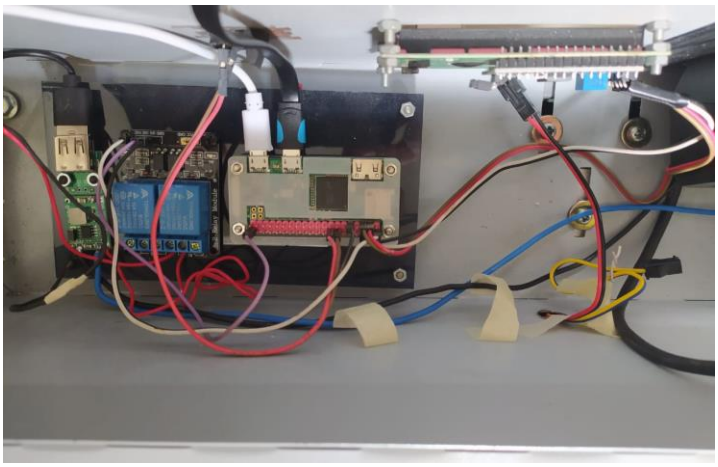


Figure 2. IoT Wiring

Raspberry Pi Zero W is used as a mini computer for all stored programs and instructions. Receipt number input is done on the Android-based application "SmartLocker" which has been connected to the cloud server via the internet. Data (MySQL) stored in the cloud server will be synchronized asynchronously with the MySQL database on the Raspberry Pi Zero W using Python. The Python program used for this IoT device consists of three main functions, among others:

1. Synchronization function between server and smartlocker
2. Synchronization function between smartlocker and server
3. Barcode scan function of package receipt number

The synchronization function with the server is divided into two with the purpose of specifying the field that is synchronized. So this aims to lighten the load on the server and prevent data from failing to synchronize.

B. Smart Locker Design

At this stage, the design of the lockers is done to carry out the electronic instructions on the program mechanically. The design of the iron plate locker is shown in Figure 3, where the smart locker has dimensions of length 50 cm x width 40 cm x height 100 cm. The smart locker is divided into three parts, among others the part of the IoT device panel which is on top, then below it there is a room to place the package, and at the bottom there is a room to take the package that has been inserted.

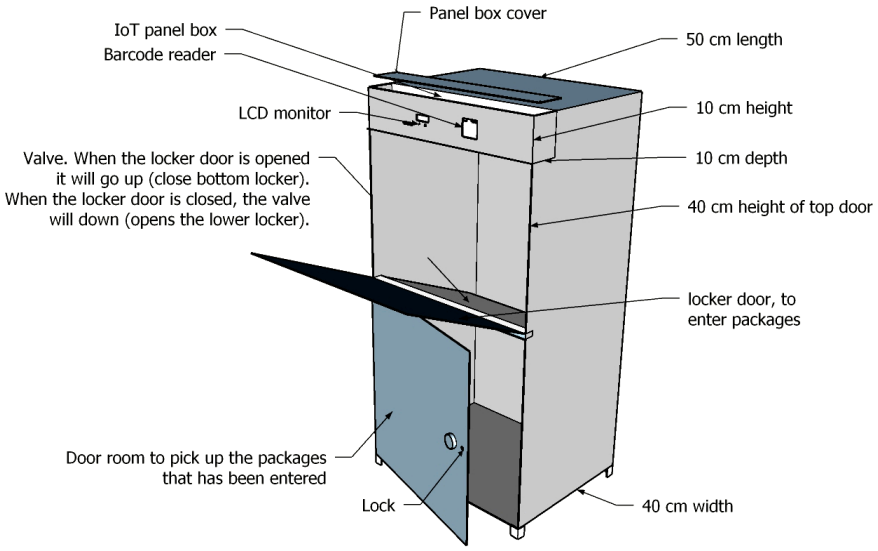


Figure 3. Smart Locker

When the barcode of the package receipt number is successfully scanned and the receipt number is in the database, the electric lock of the locker door will open. The shipping courier will place the package into the opened locker and close the locker door again. Then, the locker owner will open the door at the bottom of the locker to take the package that has been inserted.

C. Android Application Design

An Android-based application is used to manage packet data that will be entered into the smart locker. Only certain users can access data packages purchased by users from the marketplace using this SmartLocker application. The application connection diagram is shown in Figure 4. The SmartLocker app is designed using Flutter and leverages the APIs on Firebase to communicate with the database.

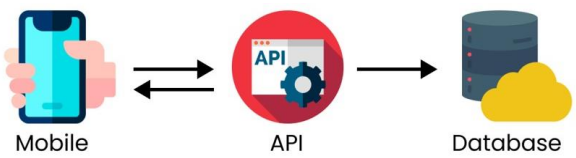


Figure 4. Android Connection Diagram

3. Result and Discussion

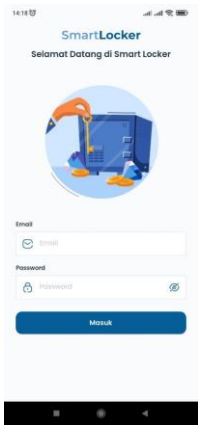
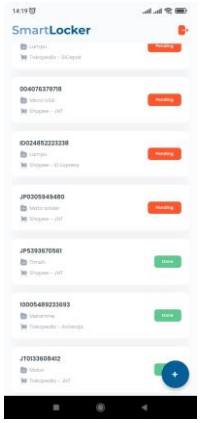
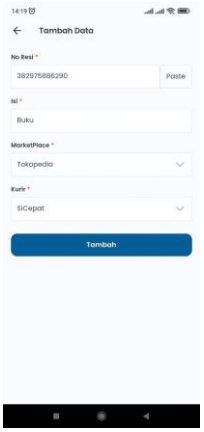
Smartlocker IoT devices have been designed and tested directly by parcel delivery couriers. Below are the results of the smart locker test table by the package delivery courier.

Table 1. Smartlocker Device Test Results

No	Photo	Test Result
1		Stand-by function with LCD displaying the text "Scan Barcode No Receipt" to receive input in the form of a scanned barcode of the receipt number of the package to be entered by the courier
2		Scanning the barcode of the receipt number of the package. The scan results will be matched with the receipt number data contained in the database.
3		If the receipt number is in the database, the locker door will open and user accept a notification in SmartLocker app, if the receipt number is not in the database, the locker door will not open.
4		When the locker door is successfully opened, the package can be placed in the place provided. Packages that have been entered previously are not visible to the courier.
5		Finally, the locker door can be closed again and will automatically lock again.

As for the SmartLocker application, the main test results are shown in the Table 2.

Table 2. SmartLocker App Test Results

No	Photo	Sub Test	Test Result
1		Open and login application	If the login is incorrect because the user does not exist in the database, the message Login Failed will be displayed. If the login is correct, the user can enter the SmartLocker application.
2		Displays the packet data that will and has been entered into the Smart Locker.	In this menu, all data packages are displayed which consist of; receipt number, package contents, marketplace, and courier of each package data. If the package has been put in the locker, then the status is 'Done', and if the locker has not been entered, the status is 'Pending'.
3		Added new package data.	Since we have not collaborated with the marketplace and shipping provider, then to add a new package, the user can select the + button at the bottom right. The Add new packet data page contains information related to the package that will be entered into the smart locker.

4. Conclusion

Smart locker devices can be well designed by integrating Internet of Things technology. The smart locker is synchronized with the cloud server using the internet network. The results of the synchronization run perfectly. Management of packages that will be entered into the smart locker using an Android-based 'SmartLocker' application, so that smart locker owners can add packages to be delivered by couriers from online shopping and receive notifications that the package has been entered

into the smart locker. In this way, the courier does not have to wait long to meet the owner of the house when delivering the package, and the package owner will receive the package safely even if it is not received directly by him.

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